

Using Bond Energies to Calculate Heats of Reaction

1. Hydrogenation reactions, which involve the addition of H_2 to a molecule, are widely used in industry to transform one compound into another. For example, 1-propene (C_3H_6) is converted to propane (C_3H_8) by addition of H_2 . Use bond energy values to estimate the enthalpy change for this hydrogenation reaction. (Note: To do this problem you must know the structure of each molecule. For 1-propene, there is a double bond between the first two carbons. Everywhere else has a single bond. For propane, there are only single bonds between each carbon in the molecule.)

2. Estimate the heat of combustion of propane from the previous problem using bond energy values. Then use heat of formation values to calculate the actual heat of combustion for the reaction. Is there much difference between each value?

3. Phosgene, Cl_2CO , is a highly toxic gas that was used as a weapon in WWI. Using bond energy values, estimate the enthalpy change for the reaction of carbon monoxide and chlorine to produce phosgene. (Draw the Lewis structures for this reaction before calculating the bond energy values.)

4. Oxygen difluoride gas is very reactive producing oxygen gas and hydrogen fluoride gas when coming in contact with water vapor. This reaction is also quite exothermic releasing 318 kJ of energy per mole of oxygen difluoride. Using bond energies, calculate the bond energy of an O—F bond in oxygen difluoride.